seated in a stationary railway coach when a train on an adjoining track moves forward. It would be more strictly comparable with the effect produced by two trains, one on each side of the stationary coach, moving forward at the same speed.

When this optical illusion receives due publicity in courses in physics, physiology and physical culture in our colleges, schools and gymnasia, there will be less danger attendent upon open-water swimming for tank-, pond- and river-trained swimmers who venture beyond their depths in larger bodies of water. And less danger will mean less loss of life.

It will be obvious to the reader that a swimmer should choose fixed objects by which to gauge his progress. But this is not the place for a discussion of the choice and use of such objects.

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SCIENTIFIC BOOKS

Flora of Bermuda. By Nathaniel Lord Britton. New York, Charles Scribner's Sons, 1918. Pp. xi + 585. Illustrated. Price $4.50.

The geographic location of the islands forming the Bermuda archipelago, distant 666 nautical miles from Sandy Hook, 700 miles from Charleston, South Carolina, 736 nautical miles to Halifax and the island of St. Thomas 800 miles away, makes their flora of unusual botanic interest. Within two days' easy sailing distance from New York, the Bermudas have been favored by American tourists, who, leaving the rigors of a northern winter behind, step off upon land with a subtropic climate. No adequate account of the interesting flora has been available to the ordinary traveler interested in the native and garden plants of the islands. A number of lists have been published from time to time, but these are inaccessible and mostly out of print. The most noteworthy of these publications, useful for the identification of the plants, are the "Challenger Report on the Botany of Bermudas" (1884), by W. B. Hemsley; "The Botany of Bermuda" (1884), by J. H. Lefroy and "Plants of the Bermudas or Somers' Islands" (1885), by O. A. Reade. The want of a compendium of the flora of the Bermudas has long been a desideratum. The reviewer felt this lack very keenly on a botanic expedition to the islands in the summer of 1905 for the purpose of ecologic investigation. The plants collected there were named by the use of the Challenger Report, which he found incomplete and unsatisfying.

Dr. Britton, after a number of visits to the islands, where he had been ably assisted by Mrs. Britton and Mr. Stewardson Brown, has at last published the results of his field, herbarium and literary studies of the Bermuda flora. He acknowledges the assistance of native Bermudians, as also American botanists, who have elaborated special groups of plants. The Flora of Bermuda is a book attractively bound in a purple binding, representing the accurately matched color of Bermudiana, *Sisyrinchium Bermudiana* L., the Bermuda blue-eyed grass, which also appears as the frontispiece. The typography of the book leaves little to be desired and the illustrations, which represent line drawings of the principal species, will enable the botanically uninitiated to determine the plants, which are native and introduced. A useful bibliography is a feature of the book and the index comprises both common and scientific names. Much interesting information, not usually incorporated in manuals of botany, is included, and rightly so. We read, for example, on page 71 under *Lilium longiflorum* Thunb., that the "Easter Lily, White Japanese Lily, is extensively grown for export in a race (*L. Harrisii* Carr,) sometimes said to have originated here, but this industry is not as important as it was some years ago, although the Lily fields are yet a very conspicuous feature in the spring. The industry commenced about 1878 and reached its greatest development from 1890 to 1903." The research of Dr. Britton and his associates has enlarged considerably our knowledge of the botanic geography of the group. The native plants of Bermuda have originated from seeds, or other parts, brought from the American mainland, or the West Indies, by the natural

agencies of wind, ocean currents and birds. About 80 per cent. of the native land plants inhabit the West Indies, or southern Florida, or both. About 8.7 per cent. of the total native flora is endemic, there being 61 species in Bermuda, or its waters, not known to grow naturally anywhere else in the world. These plants are of the greatest interest to naturalists, as they presumably developed in Bermuda from related plants formerly existing but now mostly extinct there. Of the 61 endemic plants, 11 are flowering plants, 4 are ferns and the rest are flowerless species of mosses, lichens, fungi and algæ. The total number of native species known, those that have reached Bermuda independently of human activities, and have perpetuated themselves, including the endemics mentioned above, is as follows: flowering plants 146 species; ferns and fern allies, 19 species; mosses and hepatics, 51 species; lichens, 80 species; algæ 238 species; fungi at least 175 species. This makes a grand total of 709 species. The number of introduced and completely, or partially, naturalized species, those which have reached Bermuda through human activities, is about 303. It might be added in closing this review that all groups of plants are considered in the "Flora of Bermuda." The least satisfactory portions of the whole book are those dealing with the fungi and the diatoms (*Bacillarieæ*). The description of the fungi deals with much irrelevant matter. It would have been much better to have given what is actually known about the Bermuda fungi, than to have brought in a whole lot of interesting facts about the morphology and physiology of this group of plants, which can be found in the ordinary text-books of morphologic botany, but which do not apply especially to the flora of the group of islands under consideration.

JOHN W. HARSHBERGER

SPECIAL ARTICLES

THE RYDBERG UNIVERSAL CONSTANT N_0

IN connection with some work along related lines, the author has noticed that Curtis,[1] in his work on the Balmer series of hydrogen, reduced his measured wave-lengths to vacuo incorrectly. These wave-lengths were measured on the I. A. system, and hence at 15°C., 760 mm. pressure, while Curtis, for the reduction, used Kayser's Table of Corrections,[2] which applies only to the old Rowland system, founded on 20° C., 760 mm. pressure.

The error thus introduced, for any given frequency, is approximately $^1(n-1)_0\nu$ where n = index of refraction of air at 0°C., and ν is the frequency. For the spectral range of the hydrogen Balmer series, as well as of all the ordinary helium series $(n-1)_0$ varies by only 2 or 3 per cent. of itself. Thus to this approximation the error is proportional to the frequency.

Now the main object of Curtis's work was to test the accuracy of the Balmer formula, and to derive a more accurate value for the one undetermined coefficient (the Rydberg constant N_0) which occurs in this formula. The Balmer formula is

$$\nu = N_0\left(\frac{1}{4} - \frac{1}{m^2}\right),$$

where $m = 3, 4, 5$, etc. Since the error made by Curtis is fortunately a constant per cent. of the frequency (within 3 per cent.), it will not affect the accuracy with which the formula does or does not fit the series. It will change only the value of N_0. Curtis found that he must actually use the formula

$$\nu = N_0\left(\frac{1}{4} - \frac{1}{(m+\mu)^2}\right),$$

where $\mu = 69 \times 10^{-7}$ and $N_0 = 109{,}679.22$.

The error as given above amounts (in terms of N_0) to 0.50 for H_α, 0.513 for H_β, and 0.515 for the remaining lines. The correct value of N_0 is therefore 109,678.705, which agrees very closely with the value (109,678.6) determined by the author[3] by direct conversion from the Rowland system of the best previous measurements. With this value, Curtis's formula will fit equally well for all the hydrogen lines except H_α. For this line the (obs.-calc.) will be -0.0008 *A*, instead of $+0.0001$ *A* as given by Curtis. Since the error is only in N_0 and is

[1] *Proc. Roy. Soc.*, (*A*), 90, 605, 1914.

[2] Kayser's "Handbuch," Vol. 2, p. 514.

[3] *Astro. Jour.*, 32, 114, 1910.